DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

The programs in the Directorate for Mathematical and Physical Sciences (MPS) are designed to increase the knowledge base in mathematical and physical sciences, improve the quality of education in mathematical and physical sciences in graduate and undergraduate activities, increase the rate at which advances in mathematical and physical sciences are translated into advances in science and technology on a broad spectrum and into societal benefits, and increase the diversity of people and approaches in mathematical and physical sciences.

To help the programs in MPS meet these goals, the Directorate encourages collaboration with other NSF directorates and with other agencies and industrial organizations. MPS also encourages communication among the divisions and across directorate boundaries to ensure effective support of research and education projects in emerging fields that cut across those lines.

MPS is an active participant in a number of interagency and intra-agency programs that focus on interdisciplinary areas of importance to the national interest. These programs include advanced materials and processing; biotechnology; environment and global change; high-performance computing and communications; advanced manufacturing technologies; civil infrastructure systems; and science, mathematics, engineering, and technology education. Researchers and educators interested in exploring opportunities in these areas should contact the program most closely related to their own interests to learn more about submitting proposals.

The MPS Directorate supports programs and activities through the following:

- Office of Multidisciplinary Activities (OMA)
- Division of Astronomical Sciences (AST)
- Division of Mathematical Sciences (DMS)
- Division of Physics (PHY)
- Division of Chemistry (CHE)
- Division of Materials Research (DMR)

For More Information
Visit the MPS Directorate home page, http://www.nsf.gov/home/mps/.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Office of Multidisciplinary Activities

In 1995, the Office of Multidisciplinary Activities (OMA) was established in the Directorate for Mathematical and Physical Sciences and charged with facilitating and supporting opportunities in research and education that cross traditional disciplinary boundaries. OMA works in partnership with the five MPS Divisions--Astronomical Sciences, Chemistry, Materials Research, Mathematical Sciences, and Physics--to respond more effectively to the excellence and creativity of the MPS communities, particularly to proposals that, because of their subject, scope, or multi-investigator or multidisciplinary nature, did not readily fit the existing MPS program structure.

OMA provides a focal point in the Directorate for partnerships (e.g., with other agencies, industry, national laboratories, State and local governments, and international organizations), seeds crosscutting research in areas of particular promise, and supports innovative experiments in education that could lead to new paradigms in graduate and undergraduate education in the mathematical and physical sciences, particularly in multidisciplinary settings.

OMA is open to creative ideas from all segments of the MPS community, ranging from individual investigators to centers. It especially encourages initiatives by multi-investigator, multidisciplinary teams pursuing problems on a scale that exceeds the capacity of individual investigators. OMA is particularly receptive to projects incorporating education and research training experiences that contribute to a diverse, high-quality workforce with technical and professional skills, career path flexibility, and appetite for lifelong learning appropriate to the dynamic global science and technology enterprise of the 21st century.

In addition to encouraging creative proposals from the community, OMA works with MPS Divisions to identify areas of research and education that are seen as particularly timely and promising. Three areas of emphasis for fiscal year 2003 are the development of next-generation instrumentation to enable fundamental advances within disciplines and across disciplinary boundaries; innovations in education, particularly at the graduate and undergraduate levels, that broaden the backgrounds and strengthen the technical, professional, and personal skills of graduates; and research at the interface between MPS disciplines and the biological sciences where there are extraordinary opportunities for mathematical and physical scientists to use their expertise in addressing significant research and instrumentation challenges in the biosciences and biomedical-related sciences.

In partnership with the MPS Divisions, OMA coordinates three MPS-wide activities that integrate research and education:

1. Research Experiences for Teachers (RET)

Utilizes the extensive network of Research Experiences for Undergraduates (REU) Sites as a platform for providing in-service and preservice K-12 teachers with discovery-based learning experiences in the MPS disciplines that they can incorporate into their classroom activities.

2. MPS Distinguished International Postdoctoral Research Fellowships (MPS-DRF)

Enable postdoctoral investigators in MPS disciplines to carry out research at the world's leading

facilities and laboratories. A primary objective of the MPS-DRF activity is to provide talented, recent doctoral recipients in the mathematical and physical sciences with an effective means of establishing international collaborations in the early stages of their careers, thereby facilitating and enhancing connections between the U.S. science and engineering community and its international counterparts (see program announcement NSF 01-154).

3. MPS Internships in Public Science Education (MPS-IPSE)

Are intended to bring together the expertise of the scientific research community traditionally supported by the MPS Directorate with that of the public science education community, in partnership, to communicate the most recent scientific advances to the public. The IPSE activity provides support for undergraduate and graduate students and for K-12 teachers to work in conjunction with MPS research scientists and with professionals at science centers and museums on projects in public science education (see program announcement NSF 01-39).

For More Information
Write to the Head, Office of Multidisciplinary Activities, Directorate for Mathematical and Physical Sciences, 4201 Wilson Boulevard, Room 1005, Arlington, VA 22230; or contact the office by telephone, 703-292-8803.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Division of Astronomical Sciences

The NSF is the lead Federal agency for the support of ground-based astronomy. Funding is provided through grants, contracts, and cooperative agreements awarded in response to unsolicited, investigator-initiated proposals.

Program areas in the Division of Astronomical Sciences (AST), supported primarily through individual investigator awards, include planetary astronomy, stellar astronomy and astrophysics, galactic astronomy, extragalactic astronomy, and cosmology. A broad base of observational, theoretical, and laboratory research is aimed at understanding the states of matter and physical processes in the solar system, our Milky Way galaxy, and the universe. Funding is also available for advanced technologies and instrumentation, university radio facilities, and a variety of special programs.

AST supports the development and operation of four National Astronomy Centers: National Optical Astronomy Observatory (NOAO), National Solar Observatory (NSO), National Radio Astronomy Observatory (NRAO), and National Astronomy and Ionosphere Center (NAIC). AST also provides the U.S. share of funding for the operation of the Gemini Observatory, an international partnership that has two 8-meter optical/infrared telescopes. The astronomy centers are equipped with radio, optical, infrared, and special telescopes that are made available to the scientific community on a competitive basis. Staff at the centers give technical assistance to visiting scientists, conduct research of their own, and develop advanced instrumentation. The Electromagnetic Spectrum Management Unit is responsible for ensuring that the scientific community has access to the radio spectrum for research purposes.

AST support for astronomy and astrophysics research is provided through two categories:

- Research Projects and Instrumentation
- Facilities

For More Information

Write to the Division of Astronomical Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 1045, Arlington, VA 22230; or contact the division by telephone, 703-292-8820; or visit the AST home page, http://www.nsf.gov/mps/divisions/ast/. Further information about deadlines for proposal submission is available at http://www.nsf.gov/mps/divisions/ast/news/c_deadlines.htm.

• Research Projects And Instrumentation

The Research Projects and Instrumentation category consists of the following astronomy and astrophysics grant programs:

1. Extragalactic Astronomy and Cosmology
2. Galactic Astronomy
3. Planetary Astronomy
4. Stellar Astronomy and Astrophysics
5. Education, Human Resources, and Special Programs

6. Electromagnetic Spectrum Management
7. Advanced Technologies and Instrumentation
8. University Radio Observatories

1. Extragalactic Astronomy and Cosmology (EXC)

Theoretical and observational studies of extragalactic objects-ranging from nearby galaxies to the most distant quasars-and their relevance to galactic evolution and cosmology.

2. Galactic Astronomy (GAL)

Theoretical and observational studies on the structure and evolution of the Milky Way galaxy and nearby galaxies. Research may focus on the stellar populations in these galaxies; the characteristics of star clusters; the interstellar medium; and the properties of atoms and molecular constituents of the interstellar medium.

3. Planetary Astronomy (PLA)

Theoretical and observational studies of the detailed structure and composition of planetary surfaces, interiors, atmospheres, and satellites; the nature of small bodies (asteroids and comets); and the origin and development of the solar system.

4. Stellar Astronomy and Astrophysics (SAA)

Theoretical and observational studies of the structure and activity of the Sun and other stars; the physical properties of all types of stars; all aspects of star formation and stellar evolution; stellar nucleosynthesis; and the properties of atoms and molecules of relevance to stellar astronomy.

5. Education, Human Resources, and Special Programs

Coordinates research support in special areas and educational and outreach programs that are related to astronomy. Programs include Research Experiences for Undergraduates (REU) Sites and Supplements, Faculty Early Career Development (CAREER), Presidential Early Career Awards for Scientists and Engineers (PECASE), Research at Undergraduate Institutions (RUI), Research Opportunity Awards (ROA), NSF Astronomy and Astrophysics Postdoctoral Fellowships (AAPF), and programs for underrepresented minorities. Additional information on NSF-wide programs can be found on the NSF Crosscutting Programs home page, http://www.nsf.gov/home/crssprgm/.

6. Electromagnetic Spectrum Management

Ensures the access of the scientific community to portions of the radio spectrum that are needed for research purposes. With other government agencies, coordinates the use of the radio spectrum for research purposes and obtains spectrum support for NSF radio communication systems, when required.

7. Advanced Technologies and Instrumentation

Supports the development and construction of state-of-the-art detectors and instruments for the visible, infrared, and radio regions of the spectrum; interferometric imaging instrumentation; adaptive optics; and

the application of new hardware and software technology and innovative techniques in astronomical research. Proposals should clearly identify the astronomical measurement objectives that will be enabled and include a brief task implementation plan with milestones, schedules, and costs.

8. University Radio Observatories

Supports university-based observatories as centers for focused and innovative scientific and technical achievement, emphasizing the training of young radio astronomers. Fosters hands-on involvement of students in instrument building and telescope operations to help maintain the future health of U.S. radio astronomy.

• Facilities

The Facilities section supports astronomical facilities and instrumentation that are available on a competitive basis to qualified scientists from all over the world. Telescope time is assigned after judgment of research proposals on the basis of scientific merit, the capability of the instruments to do the work, and the availability of the telescope during the requested time. The Astronomical Sciences Division supports the following facilities:

1. Gemini Observatory
2. National Astronomy and Ionosphere Center
3. National Optical Astronomy Observatory
    - Kitt Peak National Observatory
    - Cerro Tololo Inter-American Observatory
    - U.S. Gemini Program
4. National Radio Astronomy Observatory
5. National Solar Observatory

1. Gemini Observatory

An international partnership involving the United States, the United Kingdom, Canada, Australia, Chile, Brazil, and Argentina. The project involves the construction and operation of two 8-meter telescopes: one in the Northern Hemisphere on Mauna Kea, Hawaii, and one in the Southern Hemisphere on Cerro Pachon, Chile. The twin telescopes are infrared-optimized, have superb image quality, and provide unprecedented optical and infrared coverage of the northern and southern skies for astronomical research. Scientific operations began on Gemini North in 2000 and on Gemini South in summer 2001.

These telescopes provide astronomers from the partnership countries with world-class observing facilities. Observing time is assigned on the basis of scientific merit. NSF acts as the executive agency for the partnership, and the Association of Universities for Research in Astronomy, Inc.-a consortium of 20 major universities-manages the Gemini Observatory.

For More Information
Visit the Gemini Observatory home page, http://www.gemini.edu/.

2. National Astronomy and Ionosphere Center (NAIC)

A visitor-oriented national research center, supported by NSF and focusing on radio and radar astronomy and atmospheric sciences. NAIC's headquarters in Ithaca, New York, are operated and managed for NSF by Cornell University. Its principal observing facilities are 19 kilometers south of the

city of Arecibo, Puerto Rico. NAIC provides telescope users with a wide range of instrumentation for research and observation. The center has a permanent staff of scientists, engineers, and technicians who are available to help visiting investigators with their observation programs.

NAIC's principal astronomical research instrument is a 305-meter fixed spherical radio/radar telescope, the world's largest single radio wavelength reflector. Its frequency capabilities range from 25 megahertz to 10 gigahertz. Transmitters include an S-band (2,380-megahertz) radar system for planetary studies and a 430-megahertz radar system for aeronomy studies.

For More Information
Write to the Director, National Astronomy and Ionosphere Center, Cornell University, Ithaca, NY 14853; or visit the NAIC home page, http://www.naic.edu/.

3. National Optical Astronomy Observatory (NOAO)

A national center for research in ground-based optical and infrared astronomy, supported by NSF. It has large optical telescopes, observing instrumentation, and data analysis equipment. The NOAO staff of astronomers, engineers, and various support personnel are available to assist qualified visiting scientists in their use of the facilities.

NOAO, whose headquarters are in Tucson, Arizona, is operated and managed by the Association of Universities for Research in Astronomy, Inc. (AURA). NOAO is composed of the following observatories:

- **Kitt Peak National Observatory (KPNO)**—The observing facilities of KPNO are on Kitt Peak, a 2,089-meter mountain 90 kilometers southwest of Tucson, Arizona. KPNO includes the 3.5-meter WIYN telescope, the 4-meter Mayall telescope, and a 2.1-meter general-purpose reflector. Numerous other telescopes operated by universities or private consortia are also tenants on Kitt Peak. A full complement of state-of-the-art spectroscopic and imaging instrumentation is available for use on these telescopes.
- **Cerro Tololo Inter-American Observatory (CTIO)**—Qualified scientists are provided with telescopes and related facilities for astronomical research in the Southern Hemisphere. CTIO has offices, laboratories, and living quarters in the coastal city of La Serena, Chile, 482 kilometers north of Santiago. The observing facilities are on Cerro Tololo, a 2,194-meter mountain on the western slopes of the Andes, 64 kilometers inland from La Serena. CTIO operates the 4-meter Blanco telescope, which is a near twin to the 4-meter Mayall at Kitt Peak, and a general-purpose 1.5-meter reflector. These telescopes are equipped with instruments similar to those at KPNO. Several other telescopes operated by U.S. universities are also located on Cerro Tololo. A new technology 4-meter telescope (Southern Observatory for Astrophysical Research-SOAR) is under construction on nearby Cerro Pachon.
- **The U.S. Gemini Program (USGP)** at NOAO serves as the gateway to the International Gemini Observatory for the U.S. astronomical community and represents the U.S. scientific, technical, and instrumentation interests in the international community of the Gemini Project.

For More Information
Write to the Director, National Optical Astronomy Observatories, P.O. Box 26732, Tucson, AZ 85726; or visit the NOAO home page, http://www.noao.edu/noao.html.

4. National Radio Astronomy Observatory (NRAO)

Offers the use of radio astronomy facilities to qualified scientists. The staff at NRAO helps visiting scientists use the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects.

NRAO headquarters are in Charlottesville, VA. Observing sites are in Green Bank, West Virginia; a site 80 kilometers west of Socorro, New Mexico; and 10 other sites in the continental United States and on the islands of Hawaii and St. Croix, U.S. Virgin Islands. The St. Croix site includes individual antennas of the Very-Long-Baseline Array (VLBA). NRAO is supported under the terms of a cooperative agreement between NSF and Associated Universities, Inc. (AUI), the organization responsible for the operation and management of the observatory.

The new 100-meter Robert C. Byrd Green Bank Telescope, dedicated in August 2000, is now being commissioned and has begun limited scientific use. The Very Large Array (VLA) telescope, located west of Socorro, New Mexico, consists of 27 antennas and carries out aperture synthesis observations of faint radio sources at high angular resolution. The VLBA is a transcontinental network of 10 25-meter antennas that operate at frequencies ranging from 330 MHz to 43 GHz. It carries out ultra-high-resolution studies of extragalactic and galactic sources and allows users to observe both continuum and spectral line emission.

For More Information
Write to the Director, National Radio Astronomy Observatory, Edgemont Road, Charlottesville, VA 22903; or visit the NRAO home page, http://www.nrao.edu/.

5. National Solar Observatory (NSO)

Makes available to qualified scientists the world's largest collection of optical and infrared solar telescopes and auxiliary instrumentation for observation of the solar photosphere, chromosphere, and corona.

NSO has observing facilities atop Kitt Peak, Arizona, and Sacramento Peak, New Mexico (NSO/SP). Kitt Peak telescopes include the 1.5-meter McMath-Pierce Solar Telescope (the world's largest solar research instrument) and a solar vacuum telescope/magnetograph. The McMath complex is designed primarily for solar observations but is also used for planetary and stellar observations and for laboratory high-resolution spectroscopy. The principal instrument of NSO/SP is the 0.76-meter Dunn Solar Telescope, vacuum tower telescope equipped with adaptive optics to produce the world's best spatial resolution for solar studies. Also available are spectrographs and the Advanced Stokes Polarimeter. The Evans Solar Facility is a 40-centimeter aperture coronagraph with spectrographs and a coronal photometer. The NSO also operates the Global Oscillation Network Group (GONG)--a worldwide network of six solar telescopes for helioseismology--and the GONG Data Center in Tucson, Arizona. NSO is leading the design effort for a new 4-meter Advanced Technology Solar Telescope (ATST).

For More Information
Visit the NSO home page, http://www.nso.edu/; or write to the Director, National Solar Observatory, Box 62, Sunspot, NM 88349.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Division of Mathematical Sciences

The Division of Mathematical Sciences (DMS) supports a wide range of projects aimed at developing and exploring the properties and applications of mathematical structures. Most of these projects are those awarded to single investigators or small groups of investigators working with graduate students and postdoctoral researchers. Programs such as Mathematical Sciences Infrastructure handle activities that fall outside this mode.

DMS programs and activities are organized within the following:

- Disciplinary Programs
- Other Programs of Interest

Proposals for General Conferences, Workshops, Symposia, Special Years, and Related Activities in DMS

Proposals for general conferences, workshops, symposia, special years, and related activities should be submitted to the appropriate disciplinary program. Proposals should be submitted 1 year before the start of the activity. Contact the division for information on proposal requirements or see program solicitation NSF 00-109.

Specific Types of Grants Supported by DMS

In addition to the usual types of research grants awarded to principal investigators and institutions, DMS supports the following:

- **University/Industry Cooperative Research**—DMS feels it is important to provide more opportunities to conduct research and training in an industrial environment and for industrial scientists to return periodically to academia. To facilitate both research and training, the division provides Mathematical Sciences University/Industry Postdoctoral Research Fellowships, Senior Research Fellowships, and Industry-Based Graduate Research Assistantships and Cooperative Fellowships in the Mathematical Sciences.
- **Interdisciplinary Grants**—Enable faculty members to expand their skills and knowledge into areas beyond their disciplinary expertise, to subsequently apply that knowledge to their research, and to enrich the educational experiences and career options for students. These grants support interdisciplinary experiences at the principal investigator's (PI's) institution (outside the PI's department) or at academic, financial, or industrial institutions in a nonmathematical science environment.

For More Information

Write to the Division of Mathematical Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 1025, Arlington, VA 22230; or contact the division by telephone, 703-292-8870; or visit the DMS home page, http://www.nsf.gov/mps/divisions/dms/.

• Disciplinary Programs

The Division of Mathematical Sciences supports the following disciplinary programs:

1. Algebra, Number Theory, and Combinatorics
2. Analysis
3. Applied Mathematics
4. Computational Mathematics
5. Geometric Analysis
6. Statistics
7. Probability
8. Topology
9. Foundations

For More Information
Write to the Division of Mathematical Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 1025, Arlington, VA 22230; or contact the division by telephone, 703-292-8870; or visit the DMS home page, http://www.nsf.gov/mps/divisions/dms/.

1. Algebra, Number Theory, and Combinatorics

Supports research in algebra, including algebraic structures; general algebra and linear algebra; number theory, including algebraic and analytic number theory; algebraic geometry; quadratic forms and automorphic forms; and combinatorics and graph theory.

2. Analysis

Supports research on properties and behavior of solutions of differential equations; variational methods; approximations and special functions; analysis in several complex variables and singular integrals; harmonic analysis and wavelet theory; Kleinian groups and theory of functions of one complex variable; real analysis; Banach spaces, Banach algebras, and function algebras; Lie groups and their representations; harmonic analysis; ergodic theory and dynamical systems; some aspects of mathematical physics such as Schroedinger operators and quantum field theory; and operators and algebras of operators on Hilbert space.

3. Applied Mathematics

Supports research in any area of mathematics except probability or statistics. Research is expected to be motivated by or have an effect on problems arising in science and engineering, although intrinsic mathematical merit is the most important factor. Areas of interest include partial differential equations that model natural phenomena or that arise from problems in science and engineering, continuum mechanics, reaction-diffusion and wave propagation, dynamical systems, asymptotic methods, numerical analysis, variational methods, control theory, optimization theory, inverse problems, mathematics of biological or geological sciences, and mathematical physics.

4. National Radio Astronomy Observatory (NRAO)

Supports research in algorithms, numerical and symbolic methods, and research in all areas of the mathematical sciences in which computation plays a central and essential role. The prominence of computation in the research is a key distinction between Applied and Computational Mathematics.

5. Geometric Analysis

Supports research on differential geometry and its relation to partial differential equation and variational principles; aspects of global analysis including the differential geometry of complex manifolds and geometric Lie group theory; geometric methods in modern mathematical physics; and geometry of convex sets, integral geometry, discrete and combinatorial geometry, and related geometric topics.

6. Statistics

Supports research for developing and improving statistical theory and methods that are used for the collection, exploration, analysis, and interpretation of data to enable discovery and advancement in virtually all areas of science and engineering. Subfields include parametric and nonparametric inference, multivariate analysis, Bayesian analysis, experimental design, robust statistical methods, time series analysis, spatial analysis, and resampling methods.

7. Probability

Supports research on the theory and applications of probability. Subfields include discrete probability, stochastic processes, limit theory, interacting particle systems, stochastic differential and partial differential equations, and Markov processes. Research in probability which involves applications to other areas of science and engineering is especially encouraged.

8. Topology

Supports research on algebraic topology, including homotopy theory, ordinary and extraordinary homology and cohomology, cobordism theory, and K-theory; topological manifolds and cell complexes, fiberings, knots, and links; differential topology and actions of groups of transformations; geometric group theory; and general topology and continua theory.

9. Foundations

Supports research in mathematical logic and the foundations of mathematics, including proof theory, recursion theory, model theory, set theory, and infinitary combinatorics.

• Other Programs Of Interest

In addition to support in the disciplinary programs, the Division of Mathematical Sciences (DMS) offers activities that differ from the usual type of research projects. A few examples of these programs are included here. For additional programs and further information, visit the DMS home page, http://www.nsf.gov/mps/divisions/dms/.

Other programs of interest that the Division of Mathematical Sciences is involved with include:

1. Mathematical Sciences Research Institutes and Other Activities

2. Focused Research Groups
3. Grants for Vertical Integration of Research and Education
4. Cross-Disciplinary Interaction

For More Information
Write to the Division of Mathematical Sciences, National Science Foundation, 4201 Wilson Boulevard, Room 1025, Arlington, VA 22230; or contact the division by telephone, 703-292-8870; or visit the DMS home page, http://www.nsf.gov/mps/divisions/dms/.

1. Mathematical Sciences Research Institutes and Other Activities

The Division of Mathematical Sciences (DMS) currently funds seven awards given to different mathematical sciences research institutes. These projects stimulate research in all of the mathematical sciences through thematic and residential programs, workshops, and access to distinctive resources. All of the institutes offer visiting opportunities for researchers in every stage of their career and most offer postdoctoral fellowships for one or more years, with mentoring provided by outstanding scientists. Many of these centers involve new researchers, graduate students, and undergraduates through tutorials related to current programs, mathematical research experiences based on industrial or other problems, and summer schools. Interested parties are encouraged to contact the institutes directly for information on current and future programs, visiting opportunities, and other activities. The seven institutes and their web sites are:

- American Institute of Mathematics, AIM Research Conference Center, Palo Alto, CA; see http://www.aimath.org/;
- Institute for Advanced Study, School of Mathematics, Princeton, NJ; see http://www.math.ias.edu/;
- Institute for Mathematics and its Applications, Minneapolis, MN; see http://www.ima.umn.edu/;
- Institute for Pure and Applied Mathematics, Los Angeles, CA; see http://www.ipam.ucla.edu/;
- Mathematical Biosciences Institute, Columbus, OH; see http://mbi.osu.edu/;
- Mathematical Sciences Research Institute, Berkeley, CA; see http://www.msri.org/; and
- Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC; see http://www.samsi.info/.

In addition to these institutes, DMS contributes to the support of the Banff International Research Station for Mathematical Innovation and Discovery in Banff, Alberta, a joint venture between Canada and the United States (visit the station's website at http://www.pims.math.ca/birs/). This site is an international center for workshops, team research, and summer schools for mathematical sciences and mathematical challenges in science and industry.

- **Regional Conferences**—Operated by the conference board of the mathematical sciences, these conferences feature a principal speaker who gives 10 one-hour talks on a particular subject during a weeklong session.
- **Scientific Computing Research Environments in the Mathematical Sciences**—Offers moderate grants for computing equipment that will benefit groups of outstanding researchers who are highly productive but whose work has been seriously impeded by the lack of computing facilities.
- **Undergraduate Activities**—Awards are made in conjunction with NSF-wide undergraduate efforts, including Research Experiences for Undergraduates (REU), cooperative activities with the Directorate for Education and Human Resources (EHR), and other related activities. For more information on REU, visit the NSF Crosscutting Programs home page, http://www.nsf.gov/home/crssprgm/. Further information about EHR programs and activities can be found in the EHR section in this Guide.

- **Mathematical Sciences Postdoctoral Research Fellowships**—Fellowships will be awarded to between 25 and 30 new fellows in 2003. Tenure provides a research instructorship option.

Eligibility Requirements for the Mathematical Sciences Postdoctoral Research Fellowships

Each applicant will be required to submit a research plan for the tenure period requested. The fellowships are not intended to support the preparation of prior research results for publication or the writing of textbooks.

To be eligible for one of these fellowships, an individual must (1) be a citizen, national, or lawfully admitted permanent resident alien of the United States as of January 1, 2003; (2) have earned by the beginning of his or her fellowship tenure a doctoral degree in one of the mathematical sciences listed above, or have research training and experience equivalent to that represented by a Ph.D. in one of those fields; and (3) have held the doctorate for no more than 2 years, as of January 1, 2003.

2. Focused Research Groups

The mathematical sciences thrive on sharing ideas and information from various scientific fields and disciplines. Certain research needs can only be met appropriately through the use of investigative teams. The Focused Research Groups (FRG) Program supports these teams, thereby allowing groups of researchers to respond to the scientific needs of pressing importance; take advantage of current scientific opportunities; and prepare the ground for anticipated developments in the mathematical sciences. In addition to mathematical scientists, groups may include researchers from other scientific and engineering disciplines. FRG projects are highly focused scientifically, timely, limited to 3 years' duration, and substantial in both scope and impact. Projects supported through FRG are essentially collaborative in nature, their success dependent on the interaction of a group of researchers.

3. Grants for Vertical Integration of Research and Education (VIGRE)

The long-range goal of the VIGRE activity in DMS is to increase the number of U.S. citizens, nationals, and permanent residents who are well prepared to pursue careers in the mathematical sciences. VIGRE is designed to stimulate innovative educational projects that

- integrate research with educational activities;
- enhance interaction among undergraduates, graduate students, postdoctoral associates, and faculty members;
- broaden the educational experiences of its students and postdoctoral associates to prepare them for a wide range of career opportunities; and
- motivate more students to pursue an education in the mathematical sciences.

VIGRE provides funds for institutions with Ph.D.-granting departments in the mathematical sciences to support postdoctoral associate positions with enhanced opportunities for research, graduate research traineeships, and research experiences for undergraduates. The program focuses on the effectiveness of the educational experience of students and postdoctoral associates in preparing them to become successful researchers, communicators, and mentors.

4. Cross-Disciplinary Interaction

A number of areas in science and engineering have problems of great mathematical and statistical complexity or obscurity that are creating a demand for mathematical and statistical cooperation. The

depth of the problems being raised often exceeds that of the training of the scientists and engineers currently in mathematical and statistical theory. To progress in solving these problems, mathematical scientists must be sought to work in tandem with other scientists. At the same time, the problems posed often stimulate interesting, new, and deep mathematical and statistical questions that deserve attention. DMS hopes to foster interactions that require the participants to go well beyond their respective areas of expertise, to nurture young talent in the interdisciplinary mode of research, and to involve underrepresented groups whenever possible.

The following are some of the exciting research opportunities:

- In the area of biosciences and biocomplexity, striking advances in biology, computer science, and the mathematical sciences are creating opportunities to collaborate on research work in fields such as molecular biology, neuroscience, and ecosystems, and offer challenging computational and analytical problems. Biological sciences interaction may extend significantly into the core areas of mathematics, such as topology, operator algebra, probability, and nonlinear dynamical systems, as well as the more traditional areas of applied mathematics and statistics.
- Other opportunities include research in the areas of high-performance computing and communications; research in information technology; mathematical and statistical aspects of materials behavior and theoretical continuum mechanics; geosciences; advanced manufacturing technologies; mathematical sciences related to biotechnology; and mathematical, statistical, and computational aspects of global change research. Research in the area of materials includes interaction of thermal and mechanical effects; nanoscale science, phase transition, and formation of microstructures and crystals; foundations of nonlinear elasticity and electromagnetic materials; composite materials; and related mathematical questions such as control, optimization, and studies of differential equations arising in these contexts. Research opportunities in advanced manufacturing particularly emphasize simulation, modeling, and analysis of manufacturing processes and devices; applications for manufacturing of deterministic and stochastic quality control; and optimization. Mathematical science research related to biocomplexity, bioprocessing and bioconversion, bioelectronics and bionetworks, agricultural applications, and marine biotechnology is especially encouraged.
- Environmental research supports the critical development of modeling, analysis, simulation, and prediction in the context of the total Earth system. A particular emphasis is placed on analytical and computational methods for stochastic and deterministic partial differential equations and statistical techniques that encompass the full range of temporal and spatial scales. There also are opportunities in environmental technology, including pollution prevention, monitoring, and remediation. Researchers should be aware of the implications of their efforts toward such activities.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Division of Physics

The Division of Physics (PHY) supports a wide range of activities in the different subfields of physics. The primary mode of funding is to individual investigators or small groups. The division also funds the operation of two large-scale accelerator facilities (the Cornell Electron Storage Ring and the Michigan State University National Superconducting Cyclotron Laboratory); the Laser Interferometer Gravity Wave Observatory; several smaller-scale accelerators; a number of centers in atomic, molecular, and optical physics and in theoretical physics; and a new program of Physics Frontiers Centers.

The research activities in the Physics Division are inextricably linked to education and support about 800 graduate students who are fully engaged in research. Some of these activities involve substantial numbers of undergraduate students as well, especially the summer activities that are centered around the Research Experiences for Undergraduates (REU) Program. The division now supports approximately 50 REU Sites. Research activities at 4-year colleges are supported through the Research at Undergraduate Institutions (RUI) Program. The division also supports Research Experiences for Teachers through grants to provide grade K-12 science teachers with research training opportunities. In addition, the division offers significant training opportunities for young people through its support of about 500 postdoctoral positions. The division also supports outreach activities coupled to research that are intended to convey the excitement of physics to students in grades K-12 and to help educate the public at large in forefront science.

PHY supports the following programs and activities:

1. Atomic, Molecular, Optical, and Plasma Physics
2. Elementary Particle Physics
3. Gravitational Physics
4. Nuclear Physics
5. Particle and Nuclear Astrophysics
6. Theoretical Physics
7. Education and Interdisciplinary Research
8. Physics Frontiers Centers

For More Information

Write to the Division of Physics, National Science Foundation, 4201 Wilson Boulevard, Room 1015, Arlington, VA 22230; or contact the division by telephone, 703-292-8890; or visit the PHY home page, http://www.nsf.gov/mps/divisions/phy/.

1. Atomic, Molecular, Optical, and Plasma Physics

In Atomic and Molecular Physics, research is supported in areas such as quantum control, cooling and trapping of atoms and ions, low-temperature collision dynamics, the collective behavior of atoms in weakly interacting gases (Bose-Einstein Condensates), precision measurements of fundamental constants, and the effects of electron correlation on structure and dynamics. In Optical Physics, support is provided in areas such as nonlinear response of isolated atoms to intense, ultrashort electromagnetic fields; the atom/cavity interaction at high fields; and quantum properties of the electromagnetic field. In basic Plasma Physics, support focuses on the study of the behavior of plasmas in confined magnetic structures and in laser plasma interactions.

Several centers and one user facility are supported. The Joint Institute for Laboratory Astrophysics (JILA) at the University of Colorado is supported jointly with the National Institute of Standards and Technology. JILA conducts leading-edge research in many aspects of atomic, molecular, and optical physics. The Center for Ultracold Atoms, a joint MIT-Harvard University activity, conducts research in the area of Bose-Einstein condensates and coherent atom sources. The Large Aperture Plasma Device at UCLA is supported jointly with the Department of Energy as a user facility for the study of plasma waves.

2. Elementary Particle Physics

Supports research on the properties and interactions of elementary particles, the most fundamental building blocks of matter, at the frontiers of energy and sensitivity. Research includes the exploration of quarks and leptons and the interactions among these elementary constituents. The program supports university groups working at major accelerator laboratories, including those operated by the Department of Energy, and university groups involved in the construction of detectors for the Large Hadron Collider at the European Organization for Nuclear Research (CERN).

The program supports the Cornell Electron Storage Ring (CESR), which produces electron and positron colliding beams that allow detailed studies by university groups of b-meson physics and upsilon physics, and facilitates an aggressive program of synchrotron radiation research at the Cornell High-Energy Synchrotron Source, which is operated by the Division of Materials Research. CESR is among the highest luminosity electron-positron colliders in the world in this energy range. CESR also maintains a vigorous program of accelerator research and development.

3. Gravitational Physics

Emphasizes the theory of strong gravitational fields and their application to astrophysics and cosmology, computer simulations of strong and gravitational fields, and gravitational radiation; and construction of a quantum theory of gravity. The program oversees the management of the construction, commissioning, and operation of the Laser Interferometer Gravity Wave Observatory (LIGO), and provides support for LIGO users and other experimental investigations in gravitational physics and related areas.

4. Nuclear Physics

Supports research on properties and behavior of nuclei and nuclear matter under extreme conditions; the quark-gluon basis for the structure and dynamics of nuclear matter (which is now given in terms of mesons and nucleons); phase transitions of nuclear matter from normal nuclear density and temperature to the predicted high-temperature quark-gluon plasma; and basic interactions and fundamental symmetries. This research involves many probes, including intermediate-energy to multi-GeV electrons and photons; intermediate-energy light ions; low-energy to relativistic heavy ions, including radioactive beams; and non-accelerator-based studies. Other important components of the program include accelerator physics, interdisciplinary efforts, and applications to other fields.

The program supports university user groups executing experiments at a large number of laboratories in the United States and abroad, and a national user facility--the National Superconducting Cyclotron Laboratory, a superconducting, heavy-ion cyclotron facility at Michigan State University. The program also supports smaller accelerator facilities, such as those at Florida State University, the University of Notre Dame, and the State University of New York at Stony Brook.

5. Particle and Nuclear Astrophysics

Supports university groups conducting research in particle and nuclear astrophysics. Current supported activities are high-energy cosmic ray studies, solar and high-energy neutrino astrophysics, the study of gamma ray bursts, and searches for dark matter. Under construction are the Auger, HiRes, STACEE, and Milagro cosmic ray/gamma ray detectors, the Borexino solar neutrino detector, the Amanda II high-energy neutrino detector, and the CDMS II and DRIFT dark matter detectors. Support also is provided for accelerator-based nuclear astrophysics studies of stellar process, nucleosynthesis, and processes related to cosmology and the early universe.

6. Theoretical Physics

Supports the development of qualitative and quantitative understanding of fundamental physical systems, ranging from the most elementary constituents of matter through nuclei and atoms to astrophysical objects. This includes formulating new approaches for theoretical, computational, and experimental research that explore the fundamental laws of physics and the behavior of physical systems; formulating quantitative hypotheses; exploring and analyzing the implications of such hypotheses computationally; and, in some cases, interpreting the results of experiments. Support is given for research in the following areas: elementary particle physics; nuclear physics; atomic, molecular, optical, and plasma physics; astrophysics and cosmology; and a broad spectrum of topics in mathematical physics, computational physics, nonlinear dynamics, chaos, and statistical physics. The effort also includes a considerable number of interdisciplinary grants.

In addition, the program supports infrastructure activities such as the Institute for Theoretical Physics at the University of California at Santa Barbara, the Harvard-Smithsonian Institute for Theoretical Atomic, Molecular, and Optical Physics, and the Aspen Center for Physics. These activities include both short- and long-term visitor programs, workshops, and research involving the participation of external scientists from universities, national laboratories, and industry, as well as graduate students and postdoctoral fellows.

7. Education and Interdisciplinary Research

Supports activities in conjunction with NSF-wide programs such as Faculty Early Career Development (CAREER), Research Experiences for Undergraduates (REU), and programs aimed at women, minorities, and persons with disabilities. Further information about all of these programs and activities is available in the Crosscutting Investment Strategies section in this Guide.

The program also supports activities that seek to improve the education and training of physics students (both undergraduate and graduate), such as curriculum development for upper-level physics courses, and activities that are not included in specific programs elsewhere within NSF. The program supports research at the interface between physics and other disciplines, with particular emphasis on biological physics, but including medical physics and computation, and extending to emerging areas. Broadening activities related to research at the interface with other fields, possibly not normally associated with physics, also may be considered.

8. Physics Frontiers Centers (PFCs)

Support university-based centers and large groups in cases where this mode of research is required to make transformational advances in the most promising research areas. Proposals will be considered in areas within the purview of the Division of Physics, broadly interpreted-for example, atomic, molecular,

optical, plasma, elementary particle, nuclear, astro-, gravitational, interdisciplinary, and emerging areas of physics. Interdisciplinary physics is taken here to mean research at the interface between physics and other disciplines-for example, biophysics, quantum information science, and mathematical physics. The purpose of the PFC Program is to enable major advances at the intellectual frontiers of physics by providing needed resources not usually available to individual investigators or small groups. PFCs make it possible to address major challenges that require combinations of talents, skills, and/or disciplines; specialized infrastructure; large collaborations; or centers/institutes that catalyze rapid advances on the most promising research topics. Proposals are received only in response to a program solicitation. No solicitation will be released in fiscal year 2003.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Division of Chemistry

The Division of Chemistry (CHE) supports research and the development of research infrastructure in the principal subdisciplines of chemistry. The field of chemistry is very diverse, and NSF support for chemistry research goes beyond the CHE Division. Other NSF divisions supporting chemistry research include Astronomical Sciences, Atmospheric Sciences, Molecular and Cellular Biosciences, Chemical and Transport Systems, Earth Sciences, Advanced Computational Research, Physics, and Materials Research. Similarly, support for the development of infrastructure in chemistry also is provided by appropriate divisions in the Directorates for Education and Human Resources (EHR) and Biosciences (BIO) through the Division of Biological Infrastructure.

Molecular science plays a central role in many areas of science and engineering. Because of this, much of the research supported by the CHE Division will also further the advancement of research in other disciplines, such as biology and chemical engineering, and in various multidisciplinary or interdisciplinary areas, such as environmental science and materials science.

CHE supports the following programs and activities:

1. Analytical and Surface Chemistry
2. Inorganic, Bioinorganic, and Organometallic Chemistry
3. Organic Chemical Dynamics
4. Organic Synthesis
5. Experimental Physical Chemistry
6. Theoretical and Computational Chemistry
7. Chemistry of Materials
8. Office of Special Projects
9. Chemistry Research Instrumentation and Facilities

For More Information

Write to the Division of Chemistry, National Science Foundation, 4201 Wilson Boulevard, Room 1055, Arlington, VA 22230; or contact the division by telephone, 703-292-8840; or visit the CHE home page, http://www.nsf.gov/mps/divisions/che/.

1. Analytical and Surface Chemistry

Supports fundamental chemical research directed toward the characterization and analysis of all forms of matter. Studies of elemental and molecular composition and of the microstructure of both bulk and surface domains are included. The program supports projects that develop the fundamentals of measurement science, new sensors and new instruments, and innovative approaches to data processing and interpretation.

Investigations designed to probe the chemical structure and reactivity of the interface between different forms of matter also are supported. The program is linked to several other chemistry research programs within NSF, including Solid State Chemistry (Materials Research Division, MPS Directorate); Biochemistry and Biophysics (Molecular and Cellular Biosciences Division, BIO Directorate); and

Chemical Reaction Processes and Interfacial, Transport, and Separation Processes (Chemical and Transport Systems Division, ENG Directorate).

2. Inorganic, Bioinorganic, and Organometallic Chemistry

Supports research on the synthesis, properties, and reaction mechanisms of molecules composed of metals, metalloids, and nonmetals with elements covering the entire periodic table. Included are fundamental studies that underscore (1) bioinorganic reactions, (2) homogeneous catalysis and organometallic reactions, (3) photochemical and charge transfer processes, and (4) studies aimed at the rational synthesis of new inorganic molecular substances, self-assemblies, and nano-sized materials with predictable chemical, physical, and biological properties. Objectives are to provide the basis for understanding (1) the function of metal ions in biological systems, (2) the behavior of new inorganic materials and new industrial catalysts, and (3) the systematic chemistry and behavior of most of the elements and compounds in the environment. The program has links to other programs within NSF that support chemistry research, including Solid State Chemistry and Polymers (Materials Research Division, MPS Directorate); Chemical Reaction Processes (Chemical and Transport Systems Division, ENG Directorate); Biochemistry and Biophysics (Molecular and Cellular Biosciences Division, BIO Directorate); and Geochemistry (Earth Sciences Division, GEO Directorate).

3. Organic Chemical Dynamics

Supports research that will advance the knowledge of carbon-based molecules, metallo-organic systems, and organized molecular assemblies. Experimental, computational, and theoretical projects that illuminate chemical structures, reactivity, and properties and that provide organic mechanistic, structural, and kinetic foundations for the understanding of biological processes are all considered. The program has links to other programs within NSF that support chemistry research, including Solid State Chemistry and Polymers (Materials Research Division, MPS Directorate); Chemical Reaction Processes (Chemical and Transport Systems Division, ENG Directorate); Biochemistry and Biophysics (Molecular and Cellular Biosciences Division, BIO Directorate); and Atmospheric Chemistry (Atmospheric Sciences Division, GEO Directorate).

4. Organic Synthesis

Supports research on the synthesis of carbon-based molecules, organometallic systems, and organized molecular assemblies. Research includes the development of new reagents and methods for organic synthesis and characterization, and the investigation of natural products and new organic materials. Such research provides the basis for designed syntheses of new materials and natural products important to the chemical and pharmaceutical industries. The research has links to other programs within NSF that support chemistry research, including Biochemistry (Molecular and Cellular Biosciences Division, BIO Directorate) and Polymers (Materials Research Division, MPS Directorate).

5. Experimental Physical Chemistry

Supports experimental research directed at understanding the physical properties of chemical systems at a molecular level. Chemical systems include solids, liquids, interfaces, clusters, and isolated molecules or ions in gas or condensed phases. Chemical properties of interest include solute/solvent interactions in liquids and in clusters; chemical dynamics of bimolecular and unimolecular chemical processes; time-resolved internal energy redistribution; and molecular structure and the shape of the ground and excited electronic-state potential energy surfaces. Experimental methodologies include frequency domain and time domain spectroscopic techniques covering the entire range of the electromagnetic spectrum; time-resolved dynamical studies, including state-selected and mass-selected systems; reactive scattering; and single-molecule studies.

The program has links to other programs within NSF that support chemistry research, including Atomic, Molecular, and Optical Physics (Physics Division, MPS Directorate); Biophysics (Molecular and Cellular Biosciences Division, BIO Directorate); Atmospheric Chemistry (Atmospheric Sciences Division, GEO Directorate); Galactic Astronomy (Astronomical Sciences Division, MPS Directorate); Chemical and Transport Systems (ENG Directorate); and various programs in the Materials Research Division (MPS Directorate).

6. Theoretical and Computational Chemistry

Supports theoretical and computational research in areas of electronic structure, statistical mechanics, computer simulations, and chemical dynamics. The program also supports some areas of experimental thermodynamics and condensed phase dynamics of chemical systems that rely heavily on theoretical interpretation of experimental data. Areas of application span the full range of chemical systems from small molecules to macromolecules; and degrees of aggregation from clusters to macroscopic systems. The goal of projects supported in this program is to provide a molecular-level interpretation for chemical properties and reactivity. The program has links to other programs within NSF that support chemistry research, including Atomic, Molecular, and Optical Physics (Physics Division, MPS Directorate); Materials Theory (Materials Research Division, MPS Directorate); Biophysics (Molecular and Cellular Biosciences Division, BIO Directorate); and Advanced Computational Research (Advanced Computational Infrastructure and Research Division, CISE Directorate).

7. Chemistry of Materials

Supports chemistry aspects of research problems related to the design, synthesis, and characterization of advanced materials. Emphasis is on projects that take a chemistry-based molecular or supramolecular approach to materials synthesis and performance from an experimental, theoretical, and computational perspective. Current research areas include the synthesis of new molecular organic, inorganic, and organometallic precursors to polymeric, ceramic, electronic, photonic, magnetic, and biomolecular materials; chemical reactivity of polymeric, microporous, and other solid substrates; chemistry of thin films and interfaces as applied to materials performance; synthesis of new molecular nanoscopic materials with novel or improved properties; research on catalysts and reactive molecular intermediates for materials synthesis; the molecular basis of materials properties and performance, such as nonlinear optical activity, conductivity, magnetism, and liquid crystalline behavior; molecular switching and electronics; and supramolecular self-assembly. The activity is strongly linked to several programs in the Materials Research Division (MPS Directorate) and in the ENG and BIO Directorates.

8. Office of Special Projects

Supports or coordinates the support for most of the infrastructure programs and activities in which the CHE Division is involved. Examples include the Research Experiences for Undergraduates, Faculty Early Career Development, and Research Sites for Educators in Chemistry, as well as various special-purpose grants in education, outreach, diversity, and graduate training. The office also coordinates the Division's involvement in large-scale projects, such as the Environmental Molecular Science Institutes and the Science and Technology Centers. The office manages the Collaborative Research in Chemistry Program, whose purpose is to enable groups of researchers to respond to recognized scientific needs; take advantage of current scientific opportunities; or prepare the groundwork for anticipated and significant scientific developments in chemistry, broadly defined. Further information on the research centers and groups supported by the CHE Division is available at http://www.nsf.gov/mps/divisions/che/about/c_facilities.htm.

9. Chemistry Research Instrumentation and Facilities (CRIF)

Supports the purchase or upgrade of departmental multiuser instrumentation, instrumentation development, and chemistry research facilities. The first of these topics focuses on departmental development and is intended to facilitate research by grantees and potential grantees that are being supported by the CHE Division. Instrumentation development is intended to implement, test, and introduce new concepts for chemical measurement to be used on a wider scale. Chemistry research facilities provide unique, state-of-the-art instrumentation and expertise to users from the chemical sciences community. Only a few facilities are supported at any time. Individuals interested in submitting a facilities proposal must first contact the appropriate staff person in the CHE Division. CRIF interfaces with the following cross-directorate programs and activities: Major Research Instrumentation; Small Business Innovation Research; Small Business Technology Transfer; and instrumentation programs in the Materials Research Division (MPS Directorate), the Division of Undergraduate Education (EHR Directorate), the Office of Cross-Disciplinary Activities (CISE Directorate), and the Division of Biological Infrastructure (BIO Directorate). For a description of the facilities currently supported by the CHE Division, see http://www.nsf.gov/mps/divisions/che/about/c_facilities.htm.

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Division of Materials Research

The Division of Materials Research (DMR) supports a wide range of programs that address fundamental phenomena in materials, materials synthesis and processing, structure and composition, properties and performance, and materials education. DMR supports individual investigators, groups, centers, national facilities, and instrumentation. Individual investigator and group proposals do not have to be confined or targeted to a specific program; division staff work to facilitate the co-review and co-funding of highly meritorious proposals across program, division, or directorate boundaries as appropriate.

DMR-supported programs and activities are organized into the following categories:

- DMR Programs
- Other DMR Activities of Interest

For More Information

For lists of awards and abstracts, target and deadline dates for proposal submission, or further information about DMR programs and activities, visit the DMR home page, http://www.nsf.gov/mps/divisions/dmr/; or contact DMR by telephone, 703-292-8810; or write to the Division of Materials Research, National Science Foundation, 4201 Wilson Boulevard, Room 1065, Arlington, VA 22230.

• DMR Programs

The following programs comprise the Division of Materials Research (DMR):

1. Metals
2. Ceramics
3. Electronic Materials
4. Materials Theory
5. Condensed Matter Physics
6. Solid-State Chemistry
7. Polymers
8. Materials Research Science and Engineering Centers
9. Instrumentation for Materials Research
10. National Facilities

For More Information

For lists of awards and their abstracts, target dates and deadlines for proposal submission, or more information about DMR programs and activities, visit the DMR home page, http://www.nsf.gov/mps/divisions/dmr/; or contact DMR by telephone, 703-292-8810; or write to the Division of Materials Research, National Science Foundation, 4201 Wilson Boulevard, Room 1065, Arlington, VA 22230.

1. Metals

Supports research to increase understanding and predictive capabilities for relating synthesis, processing, alloy chemistry, and microstructure of metals to their physical and structural properties and performance in various applications and environments. Metals research encompasses the broad areas of physical and mechanical metallurgy. Topics supported include phase transformations and equilibria; morphology; solidification; surface modification, structure, and properties; interfaces and grain boundary structure; nanostructures; corrosion and oxidation; defects; deformation and fracture; and welding and joining.

2. Ceramics

Supports research investigating the characteristics of ceramic materials as they relate to the complex interplay among processing, development, and manipulation of microstructure, and properties and their ultimate performance in various applications and environments. The materials studied include oxides, carbides, nitrides, and other ceramics, including diamond and carbon-based materials. The microstructures investigated range from crystalline, polycrystalline, and amorphous to composite and nanostructured. Potential uses include, but are not limited to, electronic and electrical, electrochemical, structural, optical/photonic, and biological/medical applications.

3. Electronic Materials

Supports research that investigates the fundamental phenomena associated with the synthesis and processing of electronic and photonic materials. The objective is to increase fundamental understanding and develop predictive capabilities for relating synthesis, processing, and microstructure of these materials to their properties and performance in various applications and environments. Topics supported include basic processes and mechanisms associated with nucleation and growth of thin films; nanostructure definition and etching processes; bulk crystal growth; and the interrelationship among experimental conditions, phenomena, and properties.

4. Materials Theory

Supports theoretical and complementary computational research in the topical areas represented in DMR programs, including condensed matter physics, polymers, solid-state chemistry, metals, electronic materials, and ceramics. Materials Theory is the primary source of funding at NSF for condensed matter theory. The program supports fundamental research that advances conceptual, analytical, and computational techniques for materials research. A broad spectrum of research is supported using electronic structure methods, many-body theory, statistical mechanics, and Monte Carlo and molecular dynamics simulations, along with other techniques, many involving advanced scientific computing. Emphasis is on approaches that begin at the smallest appropriate length scale, such as electronic, atomic, molecular, nano-, micro-, and mesoscale, required to yield fundamental insight into material properties, processes, and behavior and to reveal new materials phenomena. Areas of recent interest include strongly correlated electron systems; low-dimensional systems; nonequilibrium phenomena, including pattern formation, microstructural evolution, and fracture; high-temperature superconductivity; nanostructured materials and mesoscale phenomena; quantum coherence and its control; and soft condensed matter, including systems of biological interest.

5. Condensed Matter Physics

Supports fundamental, experimental, and combined experiment and theory projects on the physics of

solid, liquid, and amorphous systems. Phenomena of interest include phase transitions; localization; electronic, magnetic, and lattice structure; superconductivity; elementary excitations, including electronic, magnetic, plasma, and lattice; transport, magnetic, and optical properties; and nonlinear dynamics. Low-temperature physics is represented by research on quantum fluids and solids as well as two-dimensional electron systems. Soft condensed matter research includes partially ordered fluids, colloid physics, and hybrid media involving biological molecules. Characterization and analysis of new materials by novel methods and research on condensed matter under extreme conditions-such as low temperatures, high pressures, and high magnetic fields-are of interest. Development of new experimental techniques to carry out proposed projects is encouraged.

6. Solid-State Chemistry

Supports basic research that includes understanding the atomic and molecular basis for synthesis, structure-composition-property relationships, and the processing of materials. The program is largely multidisciplinary with strong components of chemistry, physics, biology, and materials science. Special attention is given to the creation of new classes of materials exhibiting new phenomena and discovering specific materials with superior properties. Current research areas include innovative synthetic routes to new materials; characterization of materials displaying new phenomena or superior behavior; the relationships among structure, composition, and properties such as chemisorption, cooperative-assembly, transport, and reactivity; and materials preparation, processing, and optimization by chemical means. The current materials emphasis is on hybrid materials, complex materials, bio-inspired and environmental materials, and advanced materials optimization and processing.

7. Polymers

Supports basic research and education on the materials aspects of polymer science that are largely experimental and multidisciplinary, with strong components of chemistry, physics, and materials science. The program addresses synthesis, structure, morphology, processing, characterization, and structure-property relationships of polymers at the molecular level, with particular focus on new materials or materials with superior properties. The polymers studied are principally synthetic, but there is also an interest in biopolymers.

8. Materials Research Science and Engineering Centers (MRSECs)

Supports interdisciplinary materials research and education while addressing fundamental problems in science and engineering that are important to society. MRSECs require outstanding research quality and intellectual breadth, provide support for research infrastructure and flexibility in responding to new opportunities, and strongly emphasize the integration of research and education. These centers foster active collaboration between universities and other sectors, including industry, and they constitute a national network of university-based centers in materials research. MRSECs address problems of a scope or complexity requiring the advantages of scale and interdisciplinary interaction provided by a campus-based research center.

For More Information
For more information about the MRSECs including links to the research and education activities of each center, visit the MRSEC home page, http://www.mrsec.org/.

9. Instrumentation for Materials Research

Supports the development and acquisition of state-of-the-art tools to carry out advanced materials research. The program supports (1) major shared instruments essential to investigators conducting research that spans two or more disciplinary areas within DMR, or more than one NSF division, and (2) instrumentation required by one or more investigators conducting research in a single disciplinary area within DMR that has a total cost of approximately $100,000 or more. The program strongly encourages submission of proposals for the development of new instruments that have the potential to solve important materials problems, proposals that will significantly advance measurement capabilities, and proposals that could lead to new discoveries. For more information, see program announcement NSF 01-05.

10. National Facilities

Supports the operation of National User Facilities, which are research facilities with specialized instrumentation available to the scientific research community in general and the materials research community in particular. These facilities provide unique research capabilities that can be located at only a few highly specialized laboratories in the Nation. They include facilities and resources for research using high magnetic fields, ultraviolet and x-ray synchrotron radiation, small-angle neutron scattering, and nanofabrication.

For More Information

Please contact the facilities directly at the addresses listed below.

Center for High-Resolution Neutron Scattering
National Institute of Standards and Technology
Reactor Radiation Division
Gaithersburg, MD 20899
Telephone: 301-975-6242
Web address: http://rrdjazz.nist.gov/

Cornell High-Energy Synchrotron Source
Wilson Laboratory
Cornell University
Ithaca, NY 14853
Telephone: 607-255-7163
Web address: http://www.chess.cornell.edu/

National High Magnetic Field Laboratory (operated by Florida State University, the University of Florida, and Los Alamos National Laboratory)
Florida State University
1800 E. Paul Dirac Drive
Tallahassee, FL 32306-4005
Telephone: 850-644-0311 or 850-644-0850
Web address: http://www.magnet.fsu.edu/

Synchrotron Radiation Center
University of Wisconsin at Madison
3731 Schneider Drive
Stoughton, WI 53589-2200
Telephone: 608-877-2000
Web address: http://www.src.wisc.edu/

National Nanofabrication Users Network
Web address: http://www.nnun.org/

• Other DMR Activities Of Interest

The Division of Materials Research (DMR) also supports complementary activities that cut across programmatic lines in many cases. These include awards for Research Experiences for Undergraduates Sites and Supplements, Presidential Early Career Awards for Scientists and Engineers, Faculty Early Career Development, Research at Undergraduate Institutions, Research Opportunity Awards, support for underrepresented minorities, international activities, awards in materials education, and awards for faculty groups addressing problems with broader scope than traditional individual investigator grants. In addition, DMR activities are intrinsic to NSF-wide areas of focus such as nanoscale science and engineering. Some of these activities are described briefly in this section. They include:

1. Focused Research Groups
2. Research Experiences for Undergraduates and Research Experiences for Teachers
3. Materials Research and Education Awards
4. Opportunities for International Cooperation in Materials Research
5. International Materials Institutes (IMI)
6. Grant Opportunities for Academic Liaison with Industry (GOALI)

For More Information
For more detailed descriptions of these programs, visit the NSF Crosscutting Programs home page, http://www.nsf.gov/home/crssprgm/, or the DMR home page at http://www.nsf.gov/mps/divisions/dmr/.

1. Focused Research Groups (FRGs)

These are materials research projects that generally are smaller than centers (MRSECs) and address problems that require an interactive approach involving three or more investigators. This is not a new program, and there is no specific announcement or call for FRG proposals. FRG proposals are handled by individual investigator program directors in the Division of Materials Research, and are reviewed and co-reviewed among DMR and other NSF Program staff as appropriate, recognizing the collaborative, interdisciplinary aspects of such proposals. A list of FRGs currently supported by DMR is available on the DMR home page, http://www.nsf.gov/mps/divisions/dmr/research/.

2. Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET)

DMR supports more than 60 REU Sites, as well as REU supplements for undergraduate participation in research awards. Awards are made in conjunction with the NSF-wide REU Program. To foster participation by precollege science teachers in materials research, DMR also supports awards for RET in conjunction with the MPS Office of Multidisciplinary Activities. For more information on REU, visit the NSF Crosscutting Programs home page, http://www.nsf.gov/home/crssprgm/. A list of DMR-supported REU Sites is available on the DMR home page, http://www.nsf.gov/mps/divisions/dmr/research/.

3. Materials Research and Education Awards

DMR supports innovative approaches to materials education at the undergraduate and graduate levels. Awards are made annually through open competition. Current awards are listed on the DMR web page, http://www.nsf.gov/mps/divisions/dmr/research/edawards.doc.

4. Opportunities for International Cooperation in Materials Research

DMR supports a growing number of activities to enhance international cooperation in materials research. Examples include supplementary support for existing grants, international workshops, and awards for cooperative research projects and related activities. In many cases, these activities are coordinated and co-funded with the Division of International Programs and other NSF units, including the Directorate for Engineering and the MPS Office for Multidisciplinary Activities. Proposals can usually be submitted to the appropriate disciplinary program. In some cases, they are evaluated through a special competition. A specific example is the program for cooperative activities with Europe, in partnership with the European Community, described in more detail in program announcement NSF 01-105.

5. International Materials Institutes (IMI)

DMR aims to establish International Materials Institutes that will enhance international collaboration between U.S. researchers and educators and their counterparts in specific regions of the world such as Africa, the Americas, Asia, Europe, or the Pacific region. These institutes will advance fundamental materials research by coordinating international projects involving condensed matter and materials physics; solid state and materials chemistry; and the design, synthesis, characterization, and processing of materials to meet global and regional needs. The institutes must be university-based and provide a research environment that will attract leading scientists and engineers. This may be accomplished, for example, by supporting research in selected thematic areas by networking with other universities, centers, and national facilities. An important aspect of the IMI's activities will be to integrate materials research with education. For more information, see program solicitation NSF 02-096.

6. Grant Opportunities for Academic Liaison with Industry (GOALI)

DMR supports a wide range of GOALI awards in materials. The GOALI Initiative aims to synergize university-industry partnerships by making funds available to support an eclectic mix of industry-university linkages. Special interest is focused on affording the opportunity for (1) faculty, postdoctoral fellows, and students to conduct research and gain experience with production processes in an industrial setting; (2) industrial scientists and engineers to bring industry's perspective and integrative skills to academe; and (3) interdisciplinary university-industry teams to conduct long-term projects. This initiative targets high-risk/high-gain research with a focus on fundamental topics that would not have been undertaken by industry; new approaches to solving generic problems; development of innovative collaborative industry-university educational programs; and direct transfer of new knowledge between academe and industry. For more information, see the GOALI Initiative homepage at http://www.nsf.gov/home/crssprgm/goali/.